

# Case Study: 2. Land and Water Management Issues in the Lower Clarence River Catchment

## What Are Some of the Land and Water Management Issues in the Clarence River Catchment?

The Clarence River Catchment has many land and water management issues that are typical of many other catchments and estuaries along the NSW east coast.

However these issues have specific details and management options that are unique to the Clarence River. As in any catchment, all of the various land and water management options should be sustainable.

Sustainable land and water management means managing land and water without damaging ecological processes or reducing biological diversity.

Land and water within a catchment is often managed for multiple benefits that might include such things as agricultural production, biodiversity conservation, good water quality, soil health, flood mitigation and for supporting human lifestyles and living places.

Quite often there are competing interests in land use and water management outcomes. For example, an irrigator may wish to extract more water from the river in times of drought, whereas a fisher would want this water to remain in the river for wetland health and fish survival. Thus there needs to be cooperation between individuals, groups and governments to balance often opposing social, economic and environmental needs.

Sometimes people get things wrong and past practices and approaches need to be stopped, refined or modified.

Generally land use and water management options are regulated at a broad scale by Commonwealth and State legislation, and at a more detailed local or regional scale by Council and State Government Departments for such things as approvals for developments and activities. However, it is the actions of individuals at work or at home that can often play a large part in whether the natural resources of a catchment are managed in a sustainable way.



*Drained wetland on Bleechmores backswamp, source: Clarence Valley Council*

### Degradation of the Clarence Floodplain

Around ten years ago the Clarence River Floodplain was far from healthy. Wetlands had been drained, estuaries were cut off from important wetland habitat areas and water of poor quality was entering the river system. This was the outcome after more than a century of modifying the lower catchment with flood protection structures like floodgates and drains and the loss of important habitat areas to other land uses.

Flood mitigation works have been carried out for over a century on the Clarence, particularly in the 1960s and 1970s. Over the years many extensive drainage systems and hundreds of floodgates and other structures have been constructed. Their purpose has been to provide some protection from floods in both urban and rural areas along with drainage of water from the floodplain for agriculture.



*An example of floodgate structures on a drained floodplain, source: OceanWatch Australia*

Flood mitigation has also had some adverse impacts on the coastal floodplains. A combination of drainage and blockage of natural creek systems has often led to poor water quality, fish kills, and reduced habitat for fish and other aquatic species. In some areas over-drainage has resulted in acid sulfate soils being exposed

and acidic runoff and associated toxic metal pollution problems in waterways, as well as the loss or drying of some natural wetland areas.

As a result, commercial and recreational catches declined, tourism and other local businesses which depend on healthy coastal environments, particularly the availability of local wild caught seafood, suffered.

## Fixing Up Habitats on the Clarence Floodplain

There have been several initiatives/projects that have involved a wide range of stakeholders coming together and working on improving habitats on the Clarence Floodplain. This includes the Clarence Floodplain Project.

### SNAPSHOT – Clarence Floodplain Project

#### Background

It was evident that something needed to be done to improve the situation in the Clarence. A group of people came together from various backgrounds including landholders, fishermen, canegrowers, community members, as well as people involved in floodplain management from NSW Government Agencies, Local Council and the Catchment Management Authority and formed a partnership to address these issues as part of the 'Clarence Floodplain Project'. This project commenced in 1997 with the aim of improving the environmental management of the Council's flood mitigation infrastructure and trying to repair some of the past impacts of flood mitigation on floodplain ecosystems.

#### Funding and Key Stakeholders

The project is mainly funded through State and Federal Government funding grants, through organisations such as the Northern Rivers Catchment Management Authority, Department of Environment and Climate Change, the State Environmental Restoration Trust and Local Council. It is also supported by the Northern Rivers Catchment Management Authority, other NSW Government departments, the Clarence Cane Growers Association, Clarence River Fisherman's Cooperative, North Coast Environment Council, Indigenous Land Councils, the University of New England, Southern Cross University and local landholders and community groups.



*A tidal floodgate with a winch which allows for improved water exchange, source: Clarence Valley Council*

#### What Changes Were Made

One important part of the project involved using advanced floodgate technology that allowed flood mitigation structures to be modified to reduce impacts on watercourses in non-flood times, while still providing flood protection. This included tidal floodgates, winches to lift floodgates, 'fish flaps' in weirs and a range of water retention structures used to raise water levels. The installation of automatic and manually winched floodgates meant that habitat areas were no longer shut off from the estuary permanently and salty tidal waters were able to move up into these areas. Mangrove and saltmarsh wetland areas began to regenerate in response to inundation by these saline tidal waters.



*Landholders opening a winch to improve flushing of the drain and thus improve water quality, source: Clarence Valley Council*

The careful management of the floodgates and drains on the Clarence Floodplain has also been crucial to the project. Clarence Council Floodplain management staff work closely with landowners to develop Management Plans for creeks, drains and wetlands. Landowners often become the authorised 'floodgate operators' and manage the systems once modification works are completed.

As a result of some of these improved land and water management practices, the Clarence Catchment has become much healthier. Water quality has improved, fish and waterbird habitats including wetlands have undergone considerable improvement and grazing, fisheries and sugarcane productivity has increased. However, the main success of the project lies in the cooperation of stakeholders involved in the project, particularly the landowners who have made a big contribution towards this project through involvement in the planning and management of drains and watercourses on their land, operation of the water control structures, monitoring water conditions and working with Council staff.

This project demonstrates how the land use and water management actions of individual landowners can make a dramatic difference to improvements in the health of the estuary environment of the Clarence River.



*Drained wetland on the Clarence floodplain, source: Clarence Valley Council*



*Same wetland with salt couch beginning to grow once month after water works were undertaken to allow water back on the land, source: Clarence Valley Council*

### Achievements

Since the 'Clarence Floodplain Project' began more than 200 kilometres of waterways have been opened up to more regular flooding, tidal flushing and have regenerated to a much healthier condition. Some 250 landowners have been involved in the management of creeks and drains on their properties and more than 60 watercourse management plans have been developed and put into operation.

Benefits from this active management is usually a combination of the following:

- increased tidal exchange to improve water quality;
- improved passage, habitat and breeding areas for fish and other aquatic species;
- reduced risk of fish kills;
- better control of introduced aquatic weeds;
- reduced incidence of algal blooms;
- neutralisation of acid water in creeks with salt water from the river;
- raised watertables in acid sulfate areas (limiting further oxidation);
- improved drainage following floods;
- better water retention and water level control on wetland areas;
- increased grazing productivity on previously drained wetlands during drier months of the year;
- improved waterbird habitat;
- better control of ground water levels;
- stabilised bank erosion; and
- stabilised stock access points and exclusion of stock from unstable banks (areas where they are likely to bog).

### Rehabilitating the Little Broadwater

In the past the little Broadwater was a 250 hectare wetland located on the Lower Clarence Floodplain. It was naturally inundated by tidal waters flooding in and out from the sea and the wetland once contained mangroves, swamp oaks and reeds.

However in the 1920's weirs and floodgates were constructed to reduce flooding and allow the wetland to drain so it could be better suited to grazing. However this decision failed to recognise the important role estuary wetlands play in the health of the catchment. These structures isolated the wetland from the river and the land uses that followed resulted in loss of fish habitat and loss of waterbird habitat. The drainage works exposed acid sulfate soils resulting in acid discharge into Sportsmans Creek and reduced availability of the land for uses such as grazing.

Clarence Valley Landowners and the Council developed a Drain Management Plan in 2000. The area now has a winch, fish friendly floodgate, water control structure and tidal gates to reestablish tidal exchange.



An area of former broadwater wetland showing salt and acid sulfate scalding



The same area after changes that allowed normal tidal flushing and the removal of cattle. Much of the wetland vegetation is now returning, source: Clarence Valley Council

The Department of Primary Industries, WetlandCare Australia, Department of Environment and Climate Change, Northern Rivers Catchment Management Authority and both Southern Cross and New England Universities also undertook projects to help rehabilitate the wetland (e.g. fencing off wetlands to restrict cattle access).

The results to date have included:

- a reduction in acid runoff and an improved quality of water in the estuary;
- an increase in overall biodiversity including important estuary and fresh water life such as prawns, mullet, yellow fin bream, herrings, catfish, eels, freshwater turtles and the reappearance of some of the salt tolerant plants and sedges; and
- a vast increase in waterbirds including ibis, terns, brologas, storks, osprey, black swans and pelicans.

The project depended on the cooperation of landowners who benefited from improvements in land and water resource benefits as did the recreational and professional fishers.

See: Clarence Valley Council booklet “Little Broadwater – a successful partnership in the sustainable management of natural resources” at <http://www.clarence.nsw.gov.au>

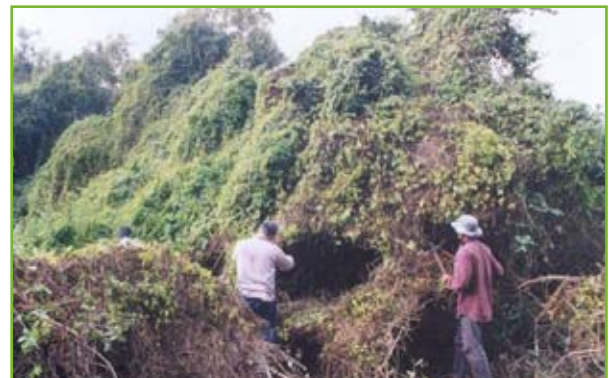
### Recreational Fishers Funding Habitat Improvements

The NSW Government has brought in a fishing licensing scheme which raises funds from the purchase of the licenses that are directed back into projects for the benefit of all fishers, as part of the NSW Recreational Fishing Trust.

In 2002 the NSW Recreational Fishing Saltwater Trust provided \$120,000 from recreational fishing license fees for a pilot fish habitat rehabilitation program in the Lower Clarence River Catchment. The community responded enthusiastically with successful applications to from individual landholders, Landcare and Rivercare groups, local angling clubs, professional fishers, local government representatives, and environment groups.

As a result 13 projects were undertaken to rehabilitate parts of the local aquatic environment. They made significant improvements to the environmental health of the estuary by achieving the following:

- rehabilitation of over 300 ha of estuarine wetland and other floodplain habitat;
- re-snagging (adding fallen branches or logs into the river for fish habitat) and removing exotic weeds and replanting riparian vegetation along river banks;
- reinstating over 10 km of fish passage by removing barriers to upstream migrations; and
- increasing community interest in and education about rehabilitation projects to improve fish habitat.



Clarence LandCare groups removing exotic weeds, source: LandCare Australia

Estuarine fish such as bream, flathead, prawns and mullet have clearly benefited from the rehabilitation of these areas where fish feed, breed and live. The recreational and commercial fishing industries have both benefited.

<http://www.wetlandlink.com.au/content/fixing-fish-habitat-in-the-clarence-estuary>

<http://www.wetlandlink.com.au/content/wetland-management>

<http://www.dpi.nsw.gov.au/fisheries/recreational/your-fees/sw-habitat>

<http://www.dpi.nsw.gov.au/fisheries/recreational/your-fees/sw-habitat/Clarence-Pilot-Habitat-Scheme.pdf>

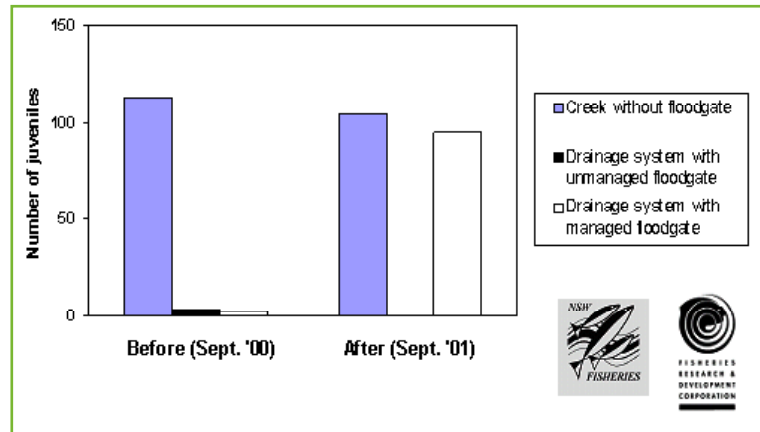
<http://www.asfb.org.au/pdf/1992/1992-07-03.pdf>

<http://www.oceanwatch.org.au/campaignAquatic.htm>

[http://www.oceanwatch.org.au/documents/t2restoringfishhabitatv2\\_000.pdf](http://www.oceanwatch.org.au/documents/t2restoringfishhabitatv2_000.pdf)

## Installing Fish Friendly Floodgates

As mentioned above, many flood mitigation structures have been put in place in the Lower Clarence River Catchment. Some of these structures were designed to reduce tidal flows to make the areas less salty and for better pasture growth (similar works were undertaken in other estuaries of coastal NSW e.g. Hunter and Macleay Rivers). All these structures impacted to some extent on the wetlands and estuarine habitats of the Clarence River Estuary. They also affected fish migrations and prevented fish life cycles from being completed and this reduced fish populations.



NSW DPI Fishing and Aquaculture – Results of a survey of juvenile Yellow Fin Bream in regulated and unregulated floodgate estuaries, source: NSW DPI

This graph below shows the effect of having floodgate barriers on fish migration. The information comes from research carried out by the Department of Primary Industries (DPI) Fishing and Aquaculture. It shows that the number of juvenile yellow-fin bream passing along creeks was reduced to almost zero when floodgates were closed. However the numbers returned almost to earlier levels when the floodgates were opened. As a result, investigations were made into managing floodgates for healthy aquatic habitats, improved fish populations while still being able to protect agricultural land behind the floodgate from most floods.

Projects such as the Clarence River Floodplain Project and the Little Broadwater Project have also benefited from this research and resulted in changes to land and water management via new floodgate installations.

NSW Fisheries at [http://www.fisheries.nsw.gov.au/aquatic\\_habitats/rehabilitating-habitats](http://www.fisheries.nsw.gov.au/aquatic_habitats/rehabilitating-habitats)

## Damming the Clarence River

One quite contentious issue that the region faced and will continue to face in the future, particularly with prolonged droughts and climate change impacts, is damming and diversion of Clarence River flood waters over or through the mountains to the drier western parts of NSW and/or possibly South East Queensland. This has been proposed in order to supplement the water supply of drier inland areas and also to supply water to areas that are proposed hot spots for development that do not currently have sufficient water supply available. This has created a level of concern from a range of stakeholders (see information boxes below/over page).

## Perspectives on Damming the Clarence River

The Federal Government and community leaders in western NSW have an eye on the Clarence River water resource and have suggested catching the flood flows in a dam before piping it to areas over the ranges where water is critically short.

The river drains close to 23,000 square kilometres of land and discharges five million megalitres of water each year to the sea between the two coastal communities of Iluka and Yamba.

A search through the archives shows there have been several attempts to dam the Clarence in the past with the first initiated around 90 years ago.

In the current debate, the river is portrayed as a potential solution to the water restriction woes of communities battling a prolonged drought along the east coast of the country.

An ABC Rural radio program – Clarence River Stories broadcast in 2007 revealed the following perspectives on the issue.

*“It’s a beautiful river and I’ve seen the problems they’ve had in the Murray Darling and other dammed rivers overseas. Why create a problem and then have to try and fix it afterwards.”* **Tourism & canoeing operator**

*“I think in a normal ordinary season, the river is flat out sustaining itself. I think when they do their sums they’ll find that there’s not enough water there.”* **Beef cattle farmer**

At a weekly elders meeting in the riverside community of Maclean, there were cries of “leave the water alone, don’t take the water.” When the issue came up for discussion among **Local Aboriginal elders**.

A **Clarence Valley Council** spokesperson said “Council will oppose any plans to take water from the Clarence River to pipe into Queensland.”

The Mayor said “the proposal will damage the health of the river, and residents will fight to protect their waterway.” **Clarence Valley Council**

*“When we flood, no-one likes the nuisance value and we all feel sorry for the people who actually have damage, but when it comes through here, you know it’s keeping your navigation channels open ... that’s critical for the fishing fleet and to keep the tourist yachts visiting Yamba.”* **Aboriginal community member**

*“Floods are a powerful feature in the catchment... that’s the time when you think yes you could grab some of that water for the western farmers but if you talk to the fisherman further down the river they really need those floods. Flood events are an important part of flushing the river ecosystem and keeping the waterway healthy.”* **Grazier and sawmill operator**

*“Over the years as a generational fisherman I’ve seen the river silt up considerably... places where you can’t even take boats anymore. So the more water that you do take away in natural flooding is going to lead to more siltation of the river.”* **Local professional fisherman**

*“The sugar industry would get some benefit from holding back 25 per cent of the floodwater. Fisherman could still rely on 75 per cent of the flow. That wouldn’t ruin their industry.”* **Cane farmer**

*“People want to eat seafood. Doctors advise us to eat seafood. Thus it is critical the we understand how important freshwater flows are for rivers and for sustaining healthy fish habitats and populations. Water that flows freely down rivers and out to sea should not be seen as a wasted resource, it is absolutely vital for the health of the whole coastal ecosystem.”* **OceanWatch Australia**

## Further Perspectives

ABC Rural Clarence River Stories at <http://www.abc.net.au/rural/features/clanceriver/>

Daily Telegraph News at <http://searchresults.news.com.au/servlet/Search> - then type "Clarence River"

OceanWatch Australia media item [www.oceawatch.org.au](http://www.oceawatch.org.au)

### Daily Telegraph, April 13th 2007

A MULTI-million dollar plan to plunder water from northern NSW rivers and pipe it to Queensland has been unveiled with the support of Prime Minister John Howard.

The water plan is in a report which gives the top five options for transporting up to 100,000 megalitres of water each year from NSW into Queensland.

The **Prime Minister** yesterday declared there was no such thing as NSW water.

*"If we're ever to solve our water problems, we have got to stop automatically thinking in terms of the reaction of jurisdictions and think nationally,"* he said.

*"As far as I'm concerned I don't care very much about state borders. I'm very sensitive to the problems of southeast Queensland. Let's be broad-minded and instead of having a knee-jerk reaction,"*

*"Oh, you can't take NSW water into Queensland. To heck with that, it's Australian water. It's not NSW water."*

However, the **NSW Premier** said:

*"There's a thriving fishing, prawning and boating industry in northern NSW and we don't support this proposal whatsoever."*

The **Clarence Valley Mayor** said if there was one issue that united the 51,000 residents living in the valley it was the 'mighty Clarence River'. *"We'll be standing shoulder to shoulder to stop the proposals going ahead,"* he said. The Mayor expected there would be job losses in the region's fishing industry if the river was dammed.

An industry representative for the **Clarence River Professional Fishermen's Association** said he feared some or many of the region's 200 professional fishermen could lose their jobs if the river was dammed.

*"The Clarence River is the lifeblood of our industry and there could be severe negative impacts from interfering with the natural flows of the river."*

### Courier Mail April 16<sup>th</sup>, 2007

On the surface, what seemed a reasonable solution to an ongoing problem was swiftly condemned by those living on and near the Clarence as politically motivated, impractical and unworkable. Scientists, fishermen and residents alike say the plan has the potential to destroy the 400km-long river system for good.

Some, like one **fisherman**, have a range of concerns. At risk, he says, is the local fishing industry and most importantly, the continued survival of the Clarence. *"It's so easy to see the Clarence as being big – it is – but it's also very touchy,"* he said. *"People think you can dam it but you can't. It's very fragile."*

A **Clarence River Professional Fishermen's Association Representative**, said the proposal was ridiculous. *"There have been cases across the world where major diversions of river systems have had disastrous consequences,"* he said. *"If this proposal goes ahead, it will have a massive negative impact on fisheries resources and the ecology in general."*

**Nature Conservation Council of NSW's Executive Director** said damming the Clarence would be enormously destructive to the biggest commercial fishery in NSW, as well as a range of agriculture and important ecosystems. *"The solution to our urban water crisis lies in a widespread rollout of rainwater tanks, vastly increased recycling and stopping water wastage, not more dams and desalination plants"* she said.

## Other Government Initiatives That Help to Improve the Health of the Lower Clarence River Catchment

Other statewide or national programmes that have and/or continue to assist to improve the health of the Clarence River estuary include:

- [Australia's National Programme of Action for the Protection of the Marine Environment from Land-based Activities](#);
- [Coastal Catchments Initiative \(CCI\)](#);
- Coast and [Clean Seas program](#) of the National Heritage Trust (NHT);
- [Cleaning Our Waterways Industry Partnership Program \(COWIPP\)](#);
- [Urban Stormwater Initiative \(USI\)](#) encourages Water Sensitive Urban Design (WSUD); and
- Landcare, Bushcare, Dunecare programmes.

<http://www.environment.gov.au/coasts/pollution/npa/pubs/townsville.pdf>

<http://www.environment.gov.au/coasts/pollution/index.html#land>

<http://www.nht.gov.au/publications/annual-reports/1997-98/pubs/partmarine.pdf>

<http://www.environment.gov.au/coasts/pollution/cowipp/index.html>

<http://www.publish.csiro.au/samples/UrbanStorm.pdf>

<http://www.landcareonline.com/page.asp?plD=75> <http://www.landcare.com.au/>

<http://www.daff.gov.au/>

<http://www.nht.gov.au/publications/brochures/bushcare.html>

<http://www.nsw.nationaltrust.org.au/bush/bush10.html>

[http://www.nsw.nationaltrust.org.au/bush\\_new/default.asp](http://www.nsw.nationaltrust.org.au/bush_new/default.asp)

<http://www.nrc.nsw.gov.au/content/documents/Standard%20for%20quality%20NRM.pdf>

<http://www.cma.nsw.gov.au/> <http://www.northern.cma.nsw.gov.au/>

Clarence Valley Council also has further important roles to play in its approval and regulation of activities within the Local Government Area (LGA). These roles include:

- landuse zoning within the LGA;
- stormwater management and providing efficient sewerage and drainage systems;
- approval of development proposals including the clearing of land;
- erosion and sediment management on its own land and the regulation of others;
- establishing best practice Development Control Plans (DCPs) requiring water sensitive urban design;
- waste disposal regulation and provision of efficient facilities;
- involvement with other organisations and landholders in specific land and water rehabilitation projects e.g. 'Clarence Floodplain Project'.

<http://www.clarence.nsw.gov.au/cmst/cvc009/nova.asp>



*LandCare groups restoring riparian habitat, source: LandCare Australia*

## What Can Individuals do to Reduce Their Impact on the Clarence Catchment and its Freshwater, Estuarine and Marine Habitats?

People who live or work in the catchment either as individuals or as part of a group all have a role to play and can contribute to the sustainable use of land and water resources and their management in the Clarence Catchment. They can make a difference and do this by:

- minimising their impact through waste minimisation and careful waste disposal;
- carrying out remedial works on affected land and water;
- sustainable use of resources;
- volunteering for habitat rehabilitation projects;
- supporting government and group initiatives to improve land and water resources; and
- complying with the law.

### *Additional Information*

NSW Department of Environment and Climate Change [www.decc.nsw.gov.au](http://www.decc.nsw.gov.au)

Australian Government Department of Environment, Water, Heritage and the Arts (DEWHA) <http://www.environment.gov.au/coasts/pollution/index.html>

Australian Maritime safety Authority [http://www.amsa.gov.au/Marine\\_Environment\\_Protection/](http://www.amsa.gov.au/Marine_Environment_Protection/)

**“Court fines dredging operator for damage to Clarence River seagrass bed” 18 May 2006**

... the court’s ruling was confirmation that there are serious consequences for unauthorised works that impact on fish habitat.

*Source: NSW DPI, note: this news release has now been archived and may contain outdated information*

## How Will Climate Change Affect the Clarence River Catchment and Sustainable Land and Water Use and Management?

Other global influences may also change the nature of the Clarence River catchment, particularly the estuary and other near coastal areas. Predictions regarding human accelerated global climate change include increased fluctuation in extremes of weather and longer term sea level changes. These phenomena would influence the Clarence River area as well as other parts of the NSW and Australian coastline. Storm surge and rainfall extremes may increase the frequency of flooding, erosion and other effects particularly on low lying coastal environments where many people live.

This table compares current and future predicted changes in weather patterns in the Northern Rivers region over the next 20 to 60 years.

### What is the current weather pattern like?

Summer weather patterns in the Northern Rivers region that includes the Clarence River catchment are relatively warm average maximum temperatures of 27-30°C during January. Yamba experiences only 1 day above 35°C in an average year. Whilst warmer and generally more inland locations such as Lismore experience more frequent temperature extremes. Winters are cool to mild with average maximum July temperatures of 19-20°C toward the coast but only 12°C at more elevated and inland locations such as Armidale. The Northern Rivers region's catchment areas receive approximately 1350-1650 mm of rainfall annually near the coast falling to about 800mm further inland. Peak precipitation occurs between November to April each year on average however variability from one year to the next can be high.

### What are the predicted climate changes for the region?

Since about 1950 the Northern Rivers region has experienced warming of around 0.8-1.3°C. This is likely to be partly due to global human activities. The region has also experienced a significant drop in annual rainfall at a rate of approximately 10mm per decade in the west and 50mm nearer the coast. How much of this is due to human activities is difficult to determine from natural variations.

From this information it is possible to predict the likely future climate for the Northern Rivers region. Generally it is likely to be warmer but projected changes in rainfall are not clear but with likely greater evaporation the region will be drier. While the trend might be to drier conditions overall there will also be a potential for increased incidence of extreme rainfall events. Climate change predictions also include increases in the number of heatwaves, extreme winds and associated bush fire risks.

[http://www.greenhouse.nsw.gov.au/\\_data/assets/pdf\\_file/0007/7828/NorthernRiversDetailedFinal.pdf](http://www.greenhouse.nsw.gov.au/_data/assets/pdf_file/0007/7828/NorthernRiversDetailedFinal.pdf)

Table 2. Current and Projected Climate Change in the Catchment Area			
	Present (1990) <sup>1</sup>	Projected Change	
		2030	2070
<b>Temperature</b>			
<b>Average</b>	Armidale: 12 – 27°C <sup>2</sup> Coffs Harbour: 19 – 27°C <sup>2</sup> Lismore: 20 – 30°C <sup>2</sup> Yamba: 19 – 27°C <sup>2</sup>	+0.2 – +1.8°C	+0.7 – +5.6°C
<b>No. Days below 0°C</b>	Yamba: 0	Yamba: 0	Yamba: 0
<b>No. Days above 35°C</b>	Yamba: 1	Yamba: 1 – 2	Yamba: 1 – 7
<b>No. Days above 40°C</b>	Yamba: 0	Yamba: 0	Yamba: 0
<b>Rainfall</b>			
<b>Annual Average</b>	Armidale: 790 mm Coffs Harbour: 1,647 mm Lismore: 1,343 mm Yamba: 1,457 mm	-7 – +7%	-20 – +20%
<b>Extreme Rainfall<sup>3</sup></b>		-10 – +5%	+5 – +10%
<b>Evaporation</b>		+1 – +13%	+4 – +40%
<b>No. Droughts per decade<sup>4</sup></b>	2	2 – 4	1 – 9
<b>Extreme Winds</b>		-5 – +8%	-16 – +24%
<b>No. Fire Days<sup>5</sup></b>	Coffs Harbour: 4	Coffs Harbour: 5 – 6	Coffs Harbour: 5 – 8

## What Effects Might Predicted Climate Change Have on Biodiversity and Rural Landuse Activities in the Northern Rivers Region?

- Reductions in stream flows are likely to have a negative impact on aquatic biodiversity and wetland ecosystems.
- Plants and animals may become 'stranded' in isolated remnants of vegetation due to changing climate and continued development within the catchment.
- More frequent droughts and fires are likely to increase stress on plants and animals.
- Sea-level rise is likely to inundate coastal wetlands and change the discharge of freshwater into estuaries, with potential negative effects on coastal wetland habitat.



*The Lower Clarence River Catchment has many low-lying residential and rural areas which will be subject to inundation from sea level rise, courtesy of DECC*

## What Things Communities in the Clarence River Catchment do to Better Prepare For and Offset These Events?

People can:

- improve water-use efficiency (waste less water; recycle more water, use appliances etc that use less water)
- reduce the reliance on surface water flow surface water during low flow conditions, such as in drought (e.g. instead of using water straight from rivers, look towards using other water sources such as rainwater, recycled water etc);
- change to crops that are more tolerant of heat and drought;
- change planting times and practices for crops;
- provide more shade and cooling for livestock;
- provide migration corridors for vulnerable wildlife; and
- review flood and fire management arrangements.

The document called Climate Change in the Northern Rivers Catchment prepared by the CSIRO and NSW Government can be found at [http://www.greenhouse.nsw.gov.au/\\_data/assets/pdf\\_file/0007/7828/NorthernRiversDetailedFinal.pdf](http://www.greenhouse.nsw.gov.au/_data/assets/pdf_file/0007/7828/NorthernRiversDetailedFinal.pdf) and provides further detailed projections for changes and impacts on the Clarence River Catchment.

### Northern Rivers Catchment Management Authority Working With Schools to Address Climate Change

The Northern Rivers Catchment Management Authority is working with schools in the region to develop environmental management plans to reduce greenhouse gas emissions. This involves carrying out an audit of water, energy, waste and resource use on the school grounds then coming up with actions to reduce resource use and greenhouse gas emissions. In addition, through student/teacher education forums, a network of students and teachers is cooperating to develop strategies to improve natural resource conditions, specifically addressing climate change impacts. <http://www.northern.cma.nsw.gov.au/education.html>

### Non-Government Organisations Working with Communities to Address Climate Change

The Nature Conservation Council of NSW has received fund from the NSW Department of Environment and Climate Change's Climate Action Grants Program to run their "Climate Challenge" initiative.



It provides easy, practical steps for individuals and communities to work together to save energy, save money and save our climate by reducing our greenhouse gas emissions.

Clarence Valley residents who have taken part in the Challenge, have so far saved over 12,800 tonnes of greenhouse gases. Many more tonnes have been saved by doing simple things like changing to energy efficient light bulbs, washing laundry in cold water, turning off appliances at the wall, and switching their electricity to Accredited Green power.

Challenge participants are now turning their attention to what they can do in the community. Saving electricity at home is very important to help stop climate change, but we can make a major and long lasting difference by working together as a community.

Residents across the Clarence Valley have formed teams to complete the Climate Challenge. From parents organising walking school buses for their kids and neighbours, to letter writing groups, to office workers making their workplaces more eco friendly, people are getting creative and making a positive difference in the public arena.

<http://www.clarence.nsw.gov.au/cmst/cvc009/lp.asp?cat=198>

[http://www.clarence.nsw.gov.au/cmst/cvc009/view\\_doc.asp?id=4033&cat=198](http://www.clarence.nsw.gov.au/cmst/cvc009/view_doc.asp?id=4033&cat=198)

## Additional Information Sources

[www.greenhouse.nsw.gov.au](http://www.greenhouse.nsw.gov.au)

[www.livingthing.net.au](http://www.livingthing.net.au)

[www.greenhouse.nsw.gov.au/\\_data/assets/pdf\\_file/0007/7828/NorthernRiversDetailedFinal.pdf](http://www.greenhouse.nsw.gov.au/_data/assets/pdf_file/0007/7828/NorthernRiversDetailedFinal.pdf)

<http://www.climatechangeinaustralia.gov.au>

<http://www.northern.cma.nsw.gov.au>

[www.nccnsw.gov.au](http://www.nccnsw.gov.au)